CLINICAL VIGNETTE

Where and how to treat a man presenting up to 4 hours after cerebral large-vessel occlusion to a thrombectomy-capable major regional hospital

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On a Sunday night (9.40 PM), a 69-year-old man with an up to 4-hour history of left-sided hemiparesis was brought by ambulance to the emergency department of a large regional hospital. The patient was last seen well by his son at 6.00 PM, as he was walking to his room to take a nap. The patient woke up just before 9.00 PM and alarmed the family due to hemiparesis. They immediately called the emergency number 112. Emergency medical services came without delay, as the patient's house is about 15 minutes drive away from the hospital.

The hospital to which the patient was admitted provides stroke service to a population of about 500 000 individuals and is one of the country leaders in stroke thrombolysis. Ten days before, the patient had undergone surgery for a trapped (incarcerated) hernia; otherwise, he had been active and well, with no known stroke risk factors.

The patient's National Institute of Health Stroke Scale score was 21. Plain computed tomography (CT) excluded intracranial bleeding and showed early infarct signs in the right middle cerebral artery (MCA) territory (FIGURE 1A). The Alberta Stroke Program Early CT Score (ASPECTS) was 8, suggesting salvageable cerebral tissue.[1] Computed tomography angiography showed the occlusion of the M1 segment of the right MCA, with a rich collateral supply (FIGURE 1D–1F) and no other extra- or intracranial vessel pathology. Thrombolysis was not administered due to the recent surgery.

Currently, there is level 1A (class IA) evidence for routine use of mechanical thrombectomy (MT) in patients with emergent large-vessel occlusion (ELVO) who meet criteria for the intervention, irrespective of whether thrombolysis has been administered or not.[1,2] The MT number needed to treat to significantly reduce disability is only 2.6.[4] Presently, there is only one stroke MT center (comprehensive stroke center, CSC; defined by the guidelines as a center performing a full range of interventional neuroradiology services, in most cases with on-site neurosurgery) listed to cover the MT needs in the country area of 3.4 million inhabitants (province; Polish: województwo). Transportation from the index hospital to the CSC lasts about 1.5 hours.

Cardiologist on call was requested to determine whether the patient was fit for transportation to the CSC. The patient had nonspecific ST-T wave changes on electrocardiogram (including a high-rise J point), which were interpreted by the consulting cardiologist on call as most likely secondary to the ongoing stroke, not requiring any urgent coronary status evaluation. As the onsite MT was not allowed, the patient was cleared for an immediate transfer to the CSC for an emergent MT as a first-line treatment.

The patient was first accepted for MT at the CSC and an immediate transport arrangement was triggered, but a few minutes later the CSC team decision was communicated to reject the patient because of "the detrimental effect of transport time on the MT treatment window" (ditto).

Follow-up CT showed evolution of the MCA infarct (FIGURE 1B). No acute coronary syndrome occurred. Two weeks later, the patient, severely disabled, was transferred to a stroke rehabilitation center.

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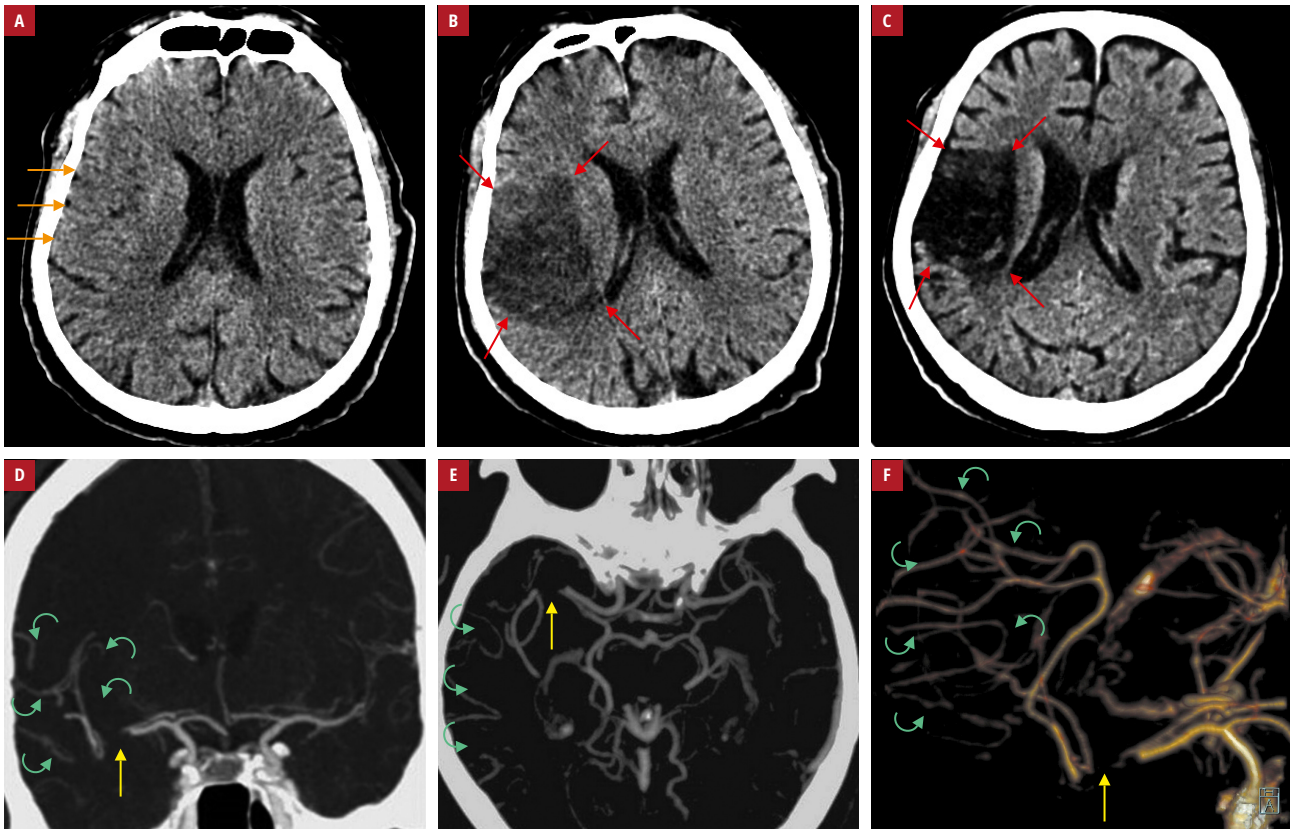

FIGURE 1 Cerebral infarct in a patient with untreated emergent large-vessel occlusion (ELVO) acute ischemic stroke. Panels **A**, **B**, and **C** show infarct evolution in the absence of level 1A (class IA) international guideline-mandated[1] management by mechanical thrombectomy: **A** – axial plain computed tomography (CT) at baseline (up to 4 hours after ELVO onset); only mild early signs of infarction with effacement of the sulci (orange arrows) and mild cortical hypodensity (ASPECTS score 8); **B**, **C** – axial, nonenhanced CT at 2 weeks (**B**) and 3 months (**C**), showing the demarked infarcted area (red arrows); **D**, **E** – CT angiography at the time of presentation (at the same time-point as in **A**), showing the occlusion of the right distal M1 segment of the middle cerebral artery (yellow arrow) and very good collateral supply (green arrows; Tan score 3) in coronal (**D**) and axial (**E**) planes. Collaterals play an important role in cerebral tissue salvage, influencing favorably the penumbra to core ratio. Evidence supports the role of collateral assessment in identifying patients likely to benefit from mechanical thrombectomy;[1] **F** – a 3-dimensional reconstruction of the baseline CT angiography with the occlusion of the M1 segment of the right middle cerebral artery (yellow arrow, coronal view) and a rich collateral supply (green arrows). Note that thrombolytic therapy (which was not implemented in this patient due to a recent major surgery) is much less effective than MT with or without intravenous thrombolysis.[1] With MT, for every 100 patients treated, 22 additional patients reach independence (modified Rankin score, 0–2) at 3 months and 33 more patients achieve early neurological recovery (Saposnik et al, see the additional reference list [Supplementary material]).

Strokes should, whenever possible, be prevented rather than experienced.[2,3] Eighty percent of strokes do not show any warning symptoms.[2,3]

Acute ischemic ELVO stroke should be treated in a timely and effective fashion, in line with the current medical knowledge and as mandated by the guidelines.[2,4] Any delay in MT reperfusion is associated with significantly increased patients' disability and limited functional independence.[2,4]

The shortage of MT-capable centers and operators is the key factor limiting the access to and delivery of MT in patients with ELVO stroke (Aguiar de Sousa et al, see the additional reference list [Supplementary material]). Evidence from the United States and Europe clearly shows that interventional cardiologists can safely perform MT in cardiac catheterization laboratories, demonstrating results similar to those in neurointerventional centers without, for operators experienced in carotid artery stenting (CAS) in particular, any long-term or extensive neurointerventional training.[4]

Establishing more thrombectomy-capable stroke centers (TCSCs; centers performing MTs in ELVO stroke; on-site neurosurgery is not a requirement as per international guidelines and regulations in Poland; patients in need of other cerebral artery interventions, such as elective malformation or aneurysm treatment, or interventions in hemorrhagic stroke secondary prevention, are routinely referred from TCSCs to a CSC) reduces patients' disability, is cost-effective, and can save lives.[4,5] However, it remains a fundamentally unfinished job, presently resulting in a continued systemic production of preventable invalids[5] (FIGURE 1).

Following multispecialty consultations, TCSC and noninterventional radiologist operator requirements have been recently agreed on and set in Poland (see reference 16 in the additional reference list [Supplementary material]). Requirements

for MT operators specialized in neurology, cardiology, angiology, or endovascular surgery include participation in at least 150 carotid or intracranial artery interventions and performing at least 50 procedures of this kind as the first operator, 5 of which have to be intracranial artery interventions (proctorship accepted).

In 2019, to address the unmet need in the region, the local hospital director set a multispecialty task force (involving specialists in cardiology, neurology, angiology, and anesthesia) to expand interventional cardiology services to in-house endovascular procedures focused on the cephalic arteries. Carotid artery stenting procedures are now regularly performed locally, for both symptomatic and asymptomatic patients at increased risk of developing stroke, who live in the region.

After more than 2 months of institutional neurorehabilitation, the patient reached a modified Rankin score of 4, necessitating help for most aspects of daily living, including using the toilet. It is highly unlikely that he will ever return to work (that is, part-time work, as the patient was retired). Rather, he will require external care to the end of his life. As per discharge summary, his family members were indicated as future caregivers.

The number of stroke patients who should, but do not (for a variety of reasons), receive MT can be calculated by subtracting the number of MTs performed from the number of patients requiring MT. The annual incidence of ELVO is 24 to 31 cases per 100 000 people. Currently, at least 10% of stroke admissions require MT, and the proportion is expected to rise with increasing public awareness and improved referral pathways.[2,4,5] According to the raw data of the Polish National Health Fund (Polish: Narodowy Fundusz Zdrowia [NFZ]), only 1111 MTs were performed in Poland, a country of 38 million inhabitants, between January and November 2019.

Fundamental challenges of delivering the guideline-indicated[1] stroke treatment in MT-eligible patients include improvements in immediate symptom recognition and referral (public awareness),[2,5] improved identification of patients who need to (and should) be treated beyond the 6-hour window,[1,2] increased number of centers and operators capable of performing MT on a true rather than theoretical 24/7/365 basis (establishing more TCSCs, as indicated internationally,[1,4,5] to complement sparsely located CSCs, lifting MT training barriers imposed on MT operators from neurology and vascular specialties), multispecialty collaboration to serve patients and not the ill-perceived "territorial" issues[4] and improvements in patient logistics including reducing delays and minimizing the negative effect of unnecessary transportation (in particular, regarding between-hospital transportations). Whereas it needs to be, again and again, reiterated that cardiologists are 100% aware that MT is not a thrombectomy-involving primary percutaneous coronary intervention[5] and that the cerebral artery is not a coronary artery,[5] those challenges reflect, in essence, the history of primary percutaneous coronary intervention implementation challenges in acute myocardial infarction.[4,5] One key difference is that, for the brain, the time means far more than for the heart.[4,5]

All in all, stroke is not a primary disease of the neuron but a vascular disease that requires, with ELVO, urgent vascular management.

SUPPLEMENTARY MATERIAL

Supplementary material is available at www.mp.pl/kardiologiapolska.

ARTICLE INFORMATION

CONFLICT OF INTEREST PM is the Polish Cardiac Society Board Representative for Stroke and Vascular Interventions and serves in the Stroke Council of the European Society of Cardiology (ESC). PM was a member of the multispecialty Stroke Thrombectomy Task Force of the Ministry of Health (Poland), which defined requirements for stroke thrombectomy-capable centers and thrombectomy operators.

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